SCHEDULE 13

PROJECT CO PROPOSAL EXTRACTS

These Project Co Proposal Extracts are in the nature of clarifications, interpretations or enhancements to the Design and Construction Requirements of the Output Specifications and, as such, are not intended to conflict with, lessen, reduce or otherwise modify or amend the Output Specifications. The intention is to reflect and capture the benefits to the Region and Project Co of the Project Co Proposal Extracts. For certainty, the Runtime Memo included in the Proposal Extracts forms part of the Project Agreement and is binding on the Parties.

The Parties acknowledge and agree that nothing in these Project Co Proposal Extracts will limit Project Co's obligation to perform and complete the Design and Construction Works and Public Infrastructure Works in accordance with the Project Agreement, including Schedule 10 - Review Procedure and the provisions of Schedule 15 - Output Specifications, and that nothing in these Project Co Proposal Extracts represents a final or approved form of any listed design concept, configuration or drawing.

Project Co acknowledges and agrees that any items, submittals and documents arising from these Project Co Proposal Extracts shall be submitted to, reviewed or otherwise processed by the Region in accordance with the Review Procedure and in the event that they are identified as being non-compliant they shall be brought into compliance with the Project Agreement (including the Project Co Proposal Extracts) at Project Co's sole cost and expense and without amendment to the Works Schedule.

All drawings referred to in these Project Co Proposal Extracts by reference only and not otherwise included in this Schedule 13 are intentionally not included in this Schedule 13 and do not form part of the Project Co Proposal Extracts.

The Project Co Proposal Extracts are as follows and include the Appendices listed below which are hereby incorporated into and form part of the Project Co Proposal Extracts:

- Appendix A – Section 2.10 OSMF
- Appendix B – Additional Lands
- Appendix C – Run Time Memo

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1.2 Project Management

1.2.1 Management Information System

GrandLinq will, as part of the Management Information System, provide the Region with a user license, User Documentation and full access to the relevant Sharepoint folders containing all of the configuration records. GrandLinq will include training for up to two personnel from the Region in all software training sessions. When requested by the Region, GrandLinq will provide two hardcopies and one electronic file containing the Project's current configuration status within seven calendar days of such requests.

1.2.7 Installation Plan

The construction discipline team that is responsible for installation will develop a work plan to follow for the installation of each component. Along with the safety and schedule information, included with the work plan are sometimes photographs of the installation process, step-by-step installation procedures, and specific information provided by the vendor to ensure a compliant, quality installation. GrandLinq is fully aware that both the schedule and budget are negatively affected as a result of any damage done to components that are already approved and delivered.

In order to prevent unexpected contact and damage, GrandLinq will exercise extreme care when marking finished work and installed components. Repeating the work is costly and therefore, taking preventative measures is the focal point of the Quality Management Plan for the Project. For certain items it is requested that a vendor’s representative is present during a particular component’s first installation in order to ensure that proper techniques are followed and also used in the future. It is common for vendors to photograph the installation and use the particular project as a model going forward.

Signing-off that components are installed per specification and undamaged is part of the Quality Testing procedure that occurs before an item is considered installed. Using the work plan as a basis for double checking the way a component has been installed, and reviewing the approved submittal and manufacturer information ensures compliance. If discrepancies are identified, or if a product does not function to the standards of the Authority, the vendor will be contacted to visit the problem and assist in developing a corrective action.

Once the components are installed, functional testing verifies proper installation, functionality and readiness for start-up. The certification of proper installation will be completed for each piece of equipment, instrument, valve, and device. Manufacturers will become actively engaged

in certifying installation, coordinating start-up activities with the start-up team, and performing their own checks and tests of equipment. Once equipment installation has been certified for each item, each manufacturer will complete a Certificate of Proper Installation and functional training forms.

1.4 Safety and Security Program

1.4.2 Safety and Security Certification

The SSCP also describes the process for safety and security certification. The Safety and Security Certification Program is implemented by GrandLinq with input from the Systems Safety and Security Certification Review Team (SSSCRT) and an Independent Verification and Validation (IV&V) team to oversee the certification effort. The Project is developed in accordance with all applicable safety regulations, standards and is certified by GrandLinq, upon recommendation from the SSSCRT. In addition to meeting the regulations, standards and industry best practices, the SSCP is implemented with the guidance provided by the SSSCRT and IV&V.

1.4.3 Safety during Construction and Testing

Initial and Ongoing Training Plans

GrandLinq believes that orientation and continuous training are absolutely critical to the success of the EHS program. To reinforce this belief, GrandLinq will implement a variety of training and awareness programs that include:

- Site specific workplace orientation for all workers, contractors and visitors
- 16-hour Supervisory training program on an annual basis to ensure appropriate stewardship of the project safety plan and Zero Harm philosophy
- All workers will receive hazard specific training and be certified, where applicable
- Daily review of work activity, hazards and controls
- Tool box talks

2.2 Civil Design Approach to Phase 1 and Phase 2

2.2.1 Civil Design Submittal Reports, Submittal Lists, and Submission Checklist

Phase 1 Design Development

Without limiting the Region's rights under the Project Agreement in respect of its consideration and pursuit of value engineering opportunities, Phase 1 is also the period where GrandLinq will work with the Region to implement any possible Value Engineering opportunities prior to finalizing the design approach through the Indicative Design submittal.

2.3 Civil Design

2.3.3 Geotechnical Design Criteria and Parameters

Table 2: Proposed Borehole Locations

LRT Elements	Proposed Boreholes	Purpose of Boreholes
Stops	3-4 boreholes per Stop (total 61 boreholes). Boreholes programmed to nominal depth of 6m, but will extend deeper if necessary where fill is encountered.	Boreholes to provide subsurface information for design of Stop structures and related facilities. Geotechnical parameters will be provided for foundation design, concrete slabs, and pavements.
TPSS	1 borehole per TPSS location to a nominal depth of 5m	Boreholes to provide subsurface information for design of TPSS foundations and related facilities. Geotechnical parameters will be provided for foundation design and pavements.

LRT Elements	Proposed Boreholes	Purpose of Boreholes
OMSF	10 boreholes to nominal depth of 6m	Boreholes to provide subsurface information for design of the OMSF facilities. Geotechnical parameters will be provided for foundation design, concrete slabs, track and pavements, and site servicing
Structures (bridges)	Typical 2 boreholes per structure (total 11 boreholes). Boreholes programmed to depth suitable for pile foundations (typ. 15 to 25m)	Boreholes to provide subsurface information for design of bridge and culvert structures. Geotechnical parameters will be provided for foundation design, earth retaining structures, and excavations/backfilling.
King Street Grade Separation	6 boreholes to depths of 15 to 20m	Boreholes to provide subsurface information for design of bridge and retaining wall structures. Geotechnical parameters will be provided for foundation design, earth retaining structures, and excavations/backfilling.
Alignment (track, pavement, and OCS poles)	Boreholes spaced at avg. 200m (total 78 boreholes) Boreholes programmed to nominal depth of 6m to provide soil data for pole foundations	Boreholes to provide subsurface information for track and pavement structures, and OCS pole support.
Public Infrastructure	10 boreholes to depths of 6 to	Boreholes to provide subsurface information for PIW underground works

LRT Elements	Proposed Boreholes	Purpose of Boreholes
Works (PIW) (those not along or immediately adjacent to alignment)	8m are planned	and pavement rehabilitation/reconstruction.
Environmental	4 boreholes planned on King Street between tracks and Moore Avenue to 8-10m depth.	Boreholes to provide soil samples for environmental laboratory testing and assessment of contamination of soil to be excavated from this area. Monitoring wells will be installed to sample and test perched groundwater if encountered.

2.4 Utility Infrastructure

2.4.4 Sanitary Sewer

Maintenance of Sanitary Services Adjacent Residential and Commercial Properties

As part of the design of the storm, sanitary and watermain design, the Region has specified that the utilities should be sized to accommodate future growth. The Design Team, using population growth forecasts, location mapping, catchment areas, and drainage areas provided by the Region will review the need to "upsize" existing utilities to accommodate future growth.

Prior to the construction phase, GrandLinq will provide each of the adjacent businesses or commercial properties with a notice outlining the proposed Project Schedule. Advanced notification will be provided for any potential disruptions. Each of the services to adjacent residential and commercial building will be maintained by "pumping around" and/or provide temporary chemical toilets during critical tie-in work. This will require that the existing sanitary flows will be pumped from an upstream manhole to a recently constructed downstream manhole thereby reducing or localizing any possible disruption of service. Within the localized area, GrandLinq will install the sanitary sewer and reconnect existing services immediately to reduce any further disruption of service. This methodology will be consistently followed throughout construction.

2.6 Energy Management Plan

2.6.2 Energy Efficiency

High Efficiency Materials and Components

An Energy Management System (EMS) capable of reliably collecting and storing the real time energy and water consumption data is extremely important to help the Region monitor and control system-wide demands. An EMS represents the Information Technology (IT) component of the energy/utility infrastructure. Components of an EMS at a minimum include; a Building Automation System (BAS) and a Utility Meter Management and Reporting Framework.

Minimizing Energy Consumption

The EMP will provide guidance, procedures and training recommendations on energy conservation related to both the operation and maintenance of the System. Drivers will be trained in energy conservation techniques such as minimizing unnecessary acceleration and braking and utilizing coasting between Stops where possible.

2.7 Track Alignment and Wayside Clearance

2.7.2 Baselines

Survey Control Line

GrandLinq will be responsible for the accuracy of the survey control and stakeout work (Figure 3) and will maintain all primary control monuments, reference benchmarks, control points, points, stakes, or other markers, throughout the term of the PA. Prior to Expiry, GrandLinq will re-establish, as required, and re-tie all control points and benchmarks. The final survey control will be suitable for confirming track alignment control points. GrandLinq will also provide these in an electronic format that is acceptable to the Region.

2.7.3 Horizontal Alignment Criteria

Establishment Appropriate Design Speed Requirements

The design speeds indicated in the RFP are based on speeds attainable within the geometric constraints of the road and property. A detailed train simulation, to be performed during detailed design, will allow GrandLinq to optimize the alignment in order to safely maximize both the freight and LRT train speeds. As a starting point, actual operating speeds, to the nearest 5km/h, will be used as design speeds for all curves.

2.8 LRT Stops and Stop Equiment

2.8.1 Design Guidelines and Design Requirements

Design Guidelines and Design Requirements for LRT Stops and Stop Equipment

The element which ties into the local community is the anchor wall, which uses a cladding that respects a particular neighborhood characteristic. These anchor walls are identifiable and act as beacons in the streetscape to guide the users to the Stop.

The Stop identification has been comprehensively assessed for the proposed System, given that the LRT alignment changes from a double track configuration to a single track configuration in three areas. This may create some confusion to the System User, as the common instinct for a departing System User is to return to the point of alighting from the LRV. As a result, GrandLinq proposes to employ the use of a color coded signage system, identifying one color per direction. The color coding strategy could also be used as part of the overall signage developed by the Region to direct the System Users to each Stop location.

Security is an important consideration in lighting design; however it can also improve the quality of the environment, providing a comfortable and attractive place for patrons. As a result, GrandLinq proposes a lighting system that is multifaceted, one that identifies a core path of travel and highlights pedestrian seating and information zones. The light will also function as a beacon that brands the character of the platform.

2.8.2 General LRT Stop Requirements

General Requirements of the Design of the LRT Stops and Stop Equipment

LRT platform canopies will be equipped with lightning protection and touch protection grounding, an added level of safety for patrons during adverse weather conditions and when in proximity to electrified systems. This will provide the high level of safety expected of System Users when using the System.

Guiding System Users through the LRT Stops needs to be efficient, safe and user friendly. GrandLinq will design appropriate signage, including both fixed System User information and electronic displays. GrandLinq will institute an easy to understand, intuitive signage system that will assist System Users when using the Stops. The design will include a continuous colour coded signage frieze that will be implemented along the full length of the platform, just below the canopy where it is easily visible, repeating the Stop name and connection available. Display boards are provided in a series of locations on and external to the platform, in order to aid System User movements. This provision will be an integral part of the System that delivers critical information to the System Users, such as maps, network information and direction of travel. Variable Message Signs (VMS) are also provided, positioned at a strategic location along each platform. These electronic displays will be controlled at the CCF and will provide real-time information to the System Users, including disruptions to service, current time of day, anticipated arrival and departure times, and special events.

2.8.4 Platform and Shelter Design Requirements

Platform and Shelter Configuration

Figure 14: Conceptual layout of platform with addition of seating, VMS and platform based TVM's (The configuration of the amenities for each Station Stop will be tailored specifically to each Station Stop.**)**

2.8.6 Specific LRT Stop Requirements

Specific LRT Stop Requirements (by location)

Uptown Waterloo (Waterloo Town Square) – Situated in the heart of Uptown Waterloo, the LRT Stop is poised in a well-developed urban hub, with shops, patios, restaurants and a civic plaza. Along the Waterloo Spur, running east/west is the Laurel Trail, the planned site for the LRT platform. The open plaza, in close proximity to the Stop, provides the opportunity to integrate the plaza directly into the LRT platform. This provides a seamless means of egress along the full length of the platform, without the need for stairs or ramps. This approach contributes promotes and maximizes barrier-free accessibility.

GrandLinq will ensure that safety is considered first and foremost when integrating the LRT Stop into a vibrant and busy public space. The urban environment surrounding the platform bestows a natural use for a contemporary pallet of architectural materials – glass and steel, selected to unify the LRT Stop with the surrounding landscape and architecture illustrates site plans for the Waterloo Town Square Stop.

2.8.8 Mechanical and Electrical Systems

The LRT Stops that correspond to the Conestoga Mall Northfield Drive, Grand River Hospital, Block Line Road, and Fairview Park Mall will include a semi-enclosed System User shelter that includes electric infrared heaters. The infrared heaters will be located to provide adequate space coverage of the shelter and to deter tampering. The heaters will be controlled by means of push button for "on-demand" heating and will be de-energized by means of a timer. The remaining Stops include sufficient rough-ins for the future addition of electric infrared heaters.

2.9 Structures

2.9.4 Materials

Concrete cover will meet the requirements of Schedule 15-2 Article 17, the CHBDC, or the Structural Manual, whichever is more stringent.

2.11 Corrosion Control and Grounding – Basis of Design

2.11.4 Soil Corrosion Prevention Systems

GrandLinq will avoid utilizing pre-stressed concrete cylinder piping in the LRT corridor if other materials of construction are suitable, primarily due to its susceptibility to stray current corrosion damage.

If non-native fill is to be used for backfilling concrete or ferrous structures, it will meet the following criteria:

- pH value of 6 to 8 (ASTM G51)
- Maximum chloride ion concentration of 250 ppm (ASTM D512 and ASTM D4327)
- Maximum sulfate ion concentration of 200 ppm (ASTM D516 and ASTM D4327)
- Minimum resistivity of 10,000 Ω-cm (ASTM G57)”

Use of fill material, which does not meet the preceding criteria, may be acceptable after review and approval by Corrosion Control Engineer

2.12 Fire/Life Safety

2.12.4 Vehicle Yard and Maintenance Facilities

Separate operations and maintenance spaces

The OMSF is designed to segregate the space for the System operator and maintainer. Although GrandLinq will fulfill both roles for the first 10 years of the concession, it is possible that the operations scope will transfer to another company following a retender of this element of the Project. As such, the OMSF is being designed to make the necessary provisions for the potential future separation of these functions

Why a backup CCF is not needed

Remote access will be provided at the GRT Operations Control Centre (OCC). This remote access will allow operators secure access to the CCF servers to allow an operator to provide basic System monitoring and communications functions.

2.12.5 System Fire/Life Safety Procedures

Approach to establishing emergency procedures with emergency responders

Training for the emergency services will continue after commissioning, and GrandLinq has agreed to make facilities available at the OMSF. GrandLinq will work with the emergency services and establish an agreed schedule of training. The EPG will be maintained after full service commencement and during operations, and continue to review and update procedures.

2.12.6 Communications

The CCF Operator will use the PA and passenger displays at the stops and on the vehicle to direct passengers and emergency responders in cases of emergency.

3.1 System Design Organization and Key Personnel

3.1.2 Key System Design Personnel

Table 1 identifies the Systems Key Personnel proposed for the Waterloo LRT project, including full or part-time status, when the role will be assumed and deployment schedule, and where the key personnel will be located.

Table 1: Key Personnel

Key Personnel Position	Key Personnel	Level of Involvement	Location	Deployment Date

		Full Time	Part Time	Region of Waterloo	Greater Toronto Area	
B3: Systems						
Chief Systems Engineer	**Eric Root**	**X**		**X**		**March, 2014**
Mr. Root has more than 15 years of experience in transportation, utility, and power generation projects. His expertise includes systems project management, electric power systems, system start-up, and interfaces for commuter and light rail systems. Mr. Root also has experience with voltage analysis and simulations, value engineering, and construction inspection and management. Mr. Root has served in progressively responsible roles, including Traction Power Engineer, Chief Systems Engineer and Lead Systems Engineer for multi-billion dollar LRT projects that stretch from Ontario, Canada down the eastern coast of the United States.						
Lead Vehicle Integration Engineer	**Steve Mudge**	**X**		**X**		**March, 2014**
Mr. Mudge has more than 20 years of experience directing and monitoring the safe and efficient operation of mass transit vehicles. During his tenure with the Massachusetts Bay Transportation Authority (MBTA), Mr. Mudge served in various roles and levels of responsibility within the agency, including Director for the multimillion-dollar procurement, maintenance, and operations programs for heavy rail and light rail vehicles. Mr. Mudge is experienced in all phases of vehicle procurement and maintenance, and led the development of MBTA's $400 million PTC initiative, to improve safety, reliability, and service delivery for customers.						
Lead Train Control Signals Engineer	**James Collier**	**X**		**X**		**March, 2014**
Mr. Collier has more than 30 years of experience as an engineering manager specializing in railroad signaling systems. He has led engineering design, installation, and modification of signaling systems for numerous metropolitan commuter agencies, including the Charlotte Area Transit System, Metropolitan Atlanta Rapid Transit Authority, Washington Metropolitan Area Transit Authority Niagara Frontier Transportation Authority and Dallas Area Rapid Transit. In addition, Mr. Collier has assisted in factory						

Key Personnel Position	Key Personnel	Level of Involvement		Location		Deployment Date
		Full Time	Part Time	Region of Waterloo	Greater Toronto Area	
B3: Systems						
and field testing and managed preventive and corrective maintenance for large commuter rail systems.						
Lead Traction Power Equipment Engineer	**Ben Stell**	**X**		**X**		**March, 2014**
Mr. Stell has more than 25 years of experience in the planning, design, and construction of railway electrical systems throughout the United States. His expertise includes system planning studies for electrified railway traction, signal and auxiliary power, and utility and industrial power distribution systems, as well as load-flow analysis programs for direct current (DC) traction power systems. His extensive systems planning experience has been complemented by numerous electrified railway design projects performed for Amtrak and other rail transportation authorities.						
Lead Overhead Contact System Engineer	**Glen Chang**	**X**		**X**		**March, 2014**
Mr. Chang has more than 35 years of experience managing and providing preliminary through final design and installation of a wide range of power transmission and distribution systems, including systems for rail traction power, rail electrification, and power plants. He has a thorough knowledge of systems and high- and low-voltage substations, as well as transmission lines. Mr. Chang has on-site experience on testing and commissioning, including renovations. He is also adept at providing design review and cost estimates and has extensive experience preparing						
Lead Communication Engineer	**Chris Hertz**	**X**		**X**		**March, 2014**
Mr. Hertz is a Project Manager and Communications Systems Engineer with more than 10 years of experience working on major rail transportation projects. He has proven expertise in supervisory control						

Key Personnel Position	Key Personnel	Level of Involvement		Location		Deployment Date
		Full Time	Part Time	Region of Waterloo	Greater Toronto Area	
B3: Systems						
and data acquisition system (SCADA), synchronous optical networking (SONET), CCTV, public address (PA), telephone, fire alarm, access control, and passenger information display (PID) systems. Mr. Hertz has particular skill in providing designs that successfully integrate and interface new systems with existing rail communications systems.						
Lead Corrosion Control Engineer (Stray Current)	**Robert Vail**	**X**		**X**		**March, 2014**
Mr. Vail has extensive experience in corrosion engineering for transit, pipeline and industrial projects, including stray current/corrosion control design and specifications for new construction rail transit systems. Mr. Vail served as the Corrosion Control Specialist MARTA's Track and Systems GEC where he updated the corrosion control program through development and implementation of procedures/policies that ensure the stray current and cor_VHrosion mitigation systems installed on the system are properly monitored and maintained for optimum effectiveness.						

3.4Traction Electrification System – Basis of Design

3.4.1 Understanding of Functional Requirements

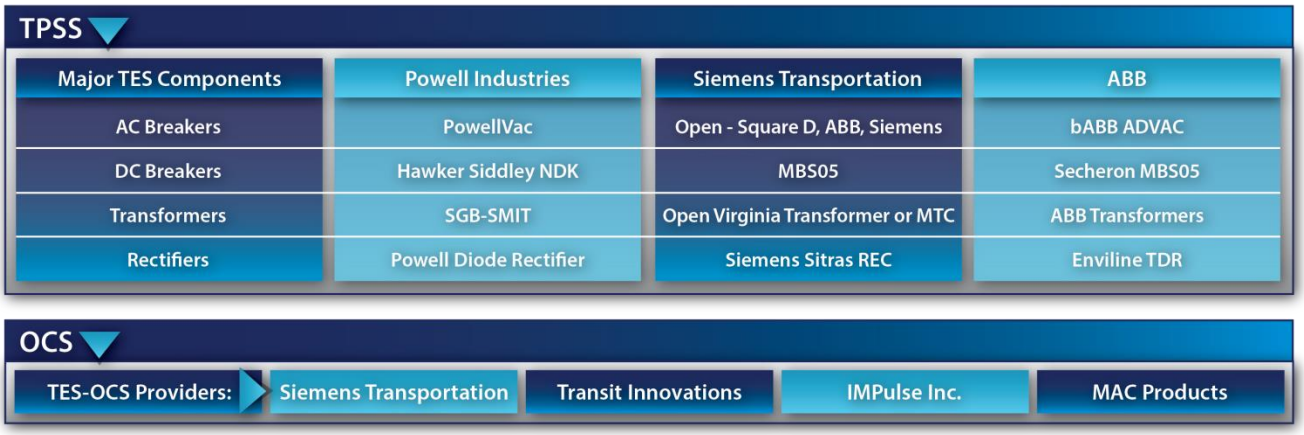
The design is based on two 13.8kV feeders being provided to each TPSS by both Hydro companies.

3.4.2 Traction Power Systems

TES Equipment Details and Potential Equipment Provider

As mentioned, potential suppliers and products that have been identified by GrandLinq through this pursuit, are listed in Table 2. From this list, GrandLinq will work with the Region to determine the appropriate technology solution to provide the above listed product, or a compliant equivalent.

Table 2: TES Details and Equipment Providers



3.4.5 Traction Power Feeder System Design Requirements

The sectioning will also include pad mounted disconnects at each substation, and there will be a dedicated disconnect for each substation feeder and two tie switches that will allow bypass of the substation, should a maintenance requirement arise.

The installation of the feeder and section break bypass disconnects on at-grade pads, rather than on the OCS poles, greatly reduces the "visual clutter" of the OCS feeder system, and also simplifies feeder switching, as all of the switches for a TPSS are found at one location. This design also improves system safety, as operations personnel are not required to enter the LRT right-of-way to perform OCS feeder or section break bypass switching.

3.4.7 Overhead Contact System

The OCS poles will be tapered tubular poles for the embedded track alignment, while wide flange columns will be used for all ballasted track alignment

3.4.8 Traction Power Distribution System

In designated areas by the Region, tubular poles will be of an ornamental style to provide for joint use with street lighting or traffic services, and be suitable for internal installation of balance weight assemblies.

3.5 Train Control System – Basis of Design

3.5.1 Understanding of Functional Requirements

In the ATP areas, GrandLinq's approach to the design will be to provide a cab signaling system, which includes Audio Frequency (AF) track circuits on the main line and single rail Power Frequency (PF) track circuits in the crossovers and turnouts for train and broken rail detection. The cab signaling system will provide safe train separation, positive speed enforcement, and absolute stop enforcement. The cab signaling system will communicate speed commands along the ATP alignment (including the hand-off between ATP areas and LOS areas, and ATP areas and yard areas) to the LRV onboard ATP equipment via AF track circuits on the mainline and cab loops through the PF track circuits in the crossovers. The cab signaling system will be designed to enforce all civil speed restrictions imposed along the alignment and all maximum speeds of the alignment in ATP areas. Wayside dwarf signals will be located at all interlocking areas to convey to the train operator the status of the interlocking.

In the LOS areas, civil speed restrictions will be governed by wayside signs. Vital loop detectors will be provided for switch protection using a check-in/check-out philosophy. Wayside LRT train signals and switch indicators will convey to the operator the status and direction of travel through the interlocking areas. Traffic loop detectors will be utilized for interface with the traffic signal controllers. The traffic controller will interface with the LRT (bar) traffic signals for train control at intersections. In both ATP and LOS areas, Train-to-Wayside Communication (TWC) loops will interface with the LRV TWC antennae, in order to support automatic routing, train identification, route cancellation and track switch calls.

The Waterloo Spur ATP area (Figure 2) is shared with the CN freight railroad. The operation of Train Control System is essential to support the movement of the freight trains. In the area of the LRT Stops, gauntlet tracks will be utilized to route the freight trains on a track with clearance of the platform. Wayside signal aspects will be utilized to govern the movement of both the freight trains and LRVs through the gauntlet tracks and crossovers/turnouts. Prior to entering the joint

track on the Waterloo Spur, the freight train will pass through a high/wide detector. This information will be conveyed to the CCF. The freight train will stop at the hold out signal located prior to the fright vehicle crossing Northfield drive and call CCF. CCF will align all switches along the Waterloo Spur for the freight train, de-energize the OCS for the appropriate track as required by CN and after all requirements are met, the motorized derail will be removed and the hold out signal will upgrade to a favorable aspect.

GrandLinq's understanding is that the Train Control System is one of the critical elements in achieving the operational headway requirement of five minutes, along with supporting a the round trip time including dwell time at LRT Stops along the alignment and layover time at the terminal LRT Stops. Vital microprocessors will interface with the cab signaling equipment, wayside apparatuses, adjacent interlocking locations, highway crossing locations, and with the non-vital microprocessor to ensure that all gated and pedestrian crossings are properly warned and traffic signal intersections are coordinated for the LRV movement authority. The non-vital processor will communicate with CCF and with the TWC equipment to ensure that the routes are properly aligned and train tracking is achieved.

The train control system will be based upon CENELEC industry standards to determine the level of system safety. In the ATP areas SIL4 will be used, In the LOS areas SIL3 will be used and SIL2 will be used in the yard and for non-vital purposes.

The Automatic Train Supervision (ATS) system will indicate back to CCF and to the local control panel the following:

- Status of switches
- Status of signals
- Train direction and locking
- Track circuit occupancy and highway crossing status along the alignment.

3.5.2 Automatic Train Supervision

The ATS system will monitor and manage the operations of the Train Control System. The ATS subsystem will monitor train traffic along the alignment in two different ways:

- GrandLinq will utilize a radio based GPS system for train location along the entire alignment.
- In the ATP area, in conjunction with the GPS system, track circuits will be utilized.

The train location information received from the LRVs GPS subsystem will be conveyed to the CCF via the onboard data radio. In the ATP areas, the track circuit occupancy will be transmitted to CCF via a non-vital processor. TWC loops located along the alignment will be utilized to provide train identification and destination routing to CCF, which will allow the CCF to manage the overall system.

The ATS system will include non-vital processors, GPS system and TWC equipment to provide the following information at a minimum:

- Location of LRV and freight vehicles
- The mode of operation
- Direction of travel and destination
- Position of all switches
- Routing information for crossover or turnout
- Signal aspects
- Highway crossing/pedestrian crossing status
- Local control panel controls and indications
- Alarm indication
- Train control system status

The train control ATS subsystem will have three different modes of operation: remote control, local control, and automatic control. When the ATS subsystem is in remote control, CCF has complete control of the routing of the LRVs through the alignments. During adverse conditions or for testing purposes, an interlocking location can be placed in local control, whereby the local control panel or workstation at that location has control of LRV routing. Although the location is in local control, CCF can monitor all indications. When the ATS subsystem is in automatic mode of operation, TWC loops along the alignment will process the trains routing destination information, and the local control panel and CCF can monitor all indications.

The train control non-vital processor will initiate all controls and indication information to and from the Local Control Panel LCP and/or CCF. This includes route initiation, switch call initiations, direction of travel, highway and pedestrian crossing status, mode of operation status of train control system and alarms.

3.5.3 Operational Design Requirements

Under normal operations, the train control system will run in automatic mode of operation. TWC loops will convey train routing information through the ATS system to the interlocking, non-vital processor so that proper routing is aligned.

3.5.5 Growth and Expansion

GrandLinq's design of the signal system will include provisions for future growth and expansion. Included in the design will be the 25 percent spare capacity in the signal houses/cases and rack spaces. The power system for the houses will also have a 25 percent spare capacity. The vital and non-vital processors will include 50 percent spare capacity and at least two spare serial ports. The ATS system will include 100 percent spare capacity for additional controls and indication to CCF. The non-vital serial communication between SCADA and TWC equipment will include additional capacity for future growth. The spare capacity of the Train Control System along with the spare fiber capacity provided by communication system will ensure that the Light Rail System will be easily expandable for future phases.

3.5.7 Train-to-wayside Communications

The TWC subsystem will have the capability to request and cancel normal operating routes, change track switch positions, interface with the Automatic Highway Crossing Warning (AHCW) Systems where necessary, provide destination routes, and provide train identification information. A Cab Control Box (CCB) onboard the LRV will interface with an antenna/transponder mounted underneath the vehicle. The antenna will transmit the TWC information to detection loops installed along the alignment. The LRVs CCB will include the following functions:

- Train ID, train destination
- Normal and reverse switch calls

- Route/crossing cancel
- Route/crossing start
- The TWC subsystem will be used as follows:
- Establish routes to enter and exit the OMSF
- Establish routes through an interlocking
- Cancel established routes
- Request a route after cancelation
- Request track switch alignment
- Identify LRV vehicles to CCF
- Activated and deactivate AHCW system during station dwells

3.6 Intelligent Transportation System- Basis of Design

3.6.4 Traffic Signal Control/Transit Priority Systems

The vendor of the new system will also provide all required set ups, installation and training to staff at the Region's Traffic Control sites and to Grandlinq staff at the CCF.

3.7 Communications – Basis of Design

3.7.3 Light Rail Communicaiton Systems

The cabinets will be 84” inches height and 24” inches in depth. The enclosures will be stainless steel NEMA 4x-rated construction with 3-point lockable doors for front and back access. An air condition unit will be installed for heating and cooling to maintain temperature between 15 and 32 degrees Celsius.

3.7.5 Communications Transmission Systems (CTS)

GrandLinq will provide fibre-optic cable plants to serve each major node along the right-of-way. The fibre backbone will consist of loose tube single mode fibres. The overall CTS will be self-healing counter rotating ring topology.

GrandLinq's approach to the CTS is to provide a fibre-optic plant cable along the alignment to connect the various field voice, data and video signals between the field and CCF. The CTS will be a minimum gigabit Ethernet system with redundant Layer 3 switches at each major node. The Ethernet switches provided will be industrially rated and sized for a minimum of 50 percent spare capacity. The CTS will be designed to consist of a minimum 96 fibres, which includes 100 percent spares. The CTS will be a self-healing counter rotating ring topology in case of operational failures and major nodes. Dark fibres will be installed for intra-system connections, for example transfer trip between TPSS units.

The 96-strand fiber-optic backbone cable will be spliced at each station communications cabinet. From the station communications cabinet, 24 strand fiber optic cabling will splice at each TPSS and CIH for providing connectivity to the CTS. Any stop field devices, including TVMs and VMS signs that require fiber optic connectivity, a minimum 6 strand fiber optic cable will be installed.

3.8 Trackwork – Basis of Design

3.8.8 Standard Track Construction Types

Embedded Track

Once the alignment is set, the rail is fully embedded in concrete using a foundation slab and one or two pours to the top-of-rail level.

3.8.11 Highway and pedestrian grade crossing materials

Where LRT curve radii are less than 150 metres, a fully embedded track solution is proposed.

3.9 Corrosion Control and Grounding – Basis of Design

3.9.5 Stray Current Corrosion Prevention Systems

The most basic monitoring procedures are to monitor the track-to-earth voltage at the traction power substations negative bus and periodically analyze the data to identify significant changes or redistribution of voltages that may indicate a change in the track-to-earth resistance.

4.2 Construction Criteria

4.2.3 Access & Protection of Property

GrandLinq will work with affected businesses and property owners to improve off-street parking through limited construction improvements to existing off-street parking lots by reconfiguring existing parking and providing improved access. Where alleys exist behind businesses, GrandLinq will work with affected property owners and businesses to enhance access to alleys and laneways and refurbish pavements where warranted to make off-street parking in these areas readily accessible and available.

4.2.14 Noise and Vibration Monitoring and Control

Construction Noise & Vibration will be monitored and controlled through the Construction Noise & Vibration Management Plan (CNVMP). The CNVMP will detail noise and vibration criteria, predict noise and vibration levels, identify affected persons and sensitive receptors, define mitigation measures, state monitoring requirements and develop communication and complaint procedures that will be implemented during construction of the LRT.

The objective of this plan is to provide a framework for the management of construction noise and vibration through better work practices and consultation with affected parties to ensure that noise and vibration levels at sensitive receptors remain within reasonable limits throughout the construction of the LRT.

The CNVMP will be prepared by a suitably qualified acoustics/vibration specialist experienced in identification of sensitive receptors, prediction, measurement, analysis and assessment of noise and vibration and further experience in ground-borne vibration and ground-borne noise in buildings adjacent to construction activity sources of vibration.

The Environmental Manager will be responsible for ensuring the CNVMP is correctly implemented and will review all documentation prepared under this plan.

All site personnel will be required to read and sign the construction noise and vibration induction form appended to this plan. If required, specific training will be provided for site personnel.

Hours of Operation

To comply with the noise and vibration criteria described herein, work at site will be conducted during Monday to Friday between the hours of 7:00 AM and 7:00 PM, and on Saturday from 7:00 AM and 7:00 PM. No work is presently scheduled to be undertaken on Sunday or on any Statutory Holiday. Should it be necessary to schedule work on Sundays and/or Statutory Holidays, prior approval will be sought from the Region.

Night Work

All construction work proposed outside of normal hours between the hours of 7:00 PM to 5:00 AM, will require documented justification for undertaking the works at night as well as noise mitigation options and consultations with affected parties. This will be provided in the form of a Night Works Management Plan (NWMP) prepared by an appropriately qualified Acoustical Engineer. The NWMP will contain the following:

- Justification for undertaking night works
- Work activity durations
- Identification of noise and vibration generating activities.
- Prediction modeling of noise and vibration levels
- Consultation Plan
- Mitigation measures to ensure noise and vibration levels meet the criteria/target levels

Where it can be demonstrated that disturbances due to construction activities can be minimized or eliminated altogether and furthermore where noise and vibration emanating from certain activities can be more easily managed and the impacts more easily mitigated through night work

then application will be made to the Region to undertake prescribed construction activities at night

Exemptions to the Noise By-Laws

Without having undertaken detailed Noise & Vibration assessments of construction activities at key sensitive receptors and without having finalized construction methodologies, it is GrandLinq's intention at this time to work within the noise target level guidelines of the noise by-laws and to implement the provisions of the CNVMP.

However, where noise monitoring indicates that Project noise criteria are being exceeded where this was not anticipated for the activity at a specific location and mitigation measures cannot ensure compliance to the CNVMP, then consideration will be given to seeking an exemption to the noise by-laws. The approach will follow that prescribed in the by-laws and will closely follow the methodology detailed herein for the development of the CNVMP. The application for noise exemption will state the reasons for seeking the exemption and will state reset noise and vibration criteria, predict noise and vibration levels, identify affected persons and sensitive receptors, define mitigation measures, state monitoring requirements and develop communication and complaint procedures that will be implemented

Sensitive Receptors

There is mixed use development along the LRT alignment with residential developments, industrial plants, commercial buildings, schools, hospitals, nursing homes, retirement homes and academic institutions, all of which can be classified as sensitive receptors with residential developments being the primary sensitive receptor. Attention will be given to academic research facilities and manufacturing facilities that contain equipment sensitive to impact from vibration levels.

The CNVMP will include all previously identified sensitive receptors identified in Appendix F "Noise and Vibration Impact Assessment Report" as well as well as the heritage and historically significant structures identified in Appendix H "Cultural Heritage Resource Assessment Report of the Environmental Project Report. Included also will be the list of heritage and historically significant structures detailed in Schedule 15-2; Article 18, Exhibit 18.6-1 of the Output Specifications.

Stakeholder Engagement

A key aspect of this CNVMP is stakeholder engagement. Where site specific noise and vibration plans are developed, locally affected stakeholders will be identified and presented with the specific plan upon completion. They will be kept informed and consulted as the work of each specific plan progresses.

Communication with stakeholders and the wider community regarding construction noise and vibration issues will be conducted within the following framework:

Owners and occupants of properties within the zone of influence of the scheduled construction activity will be notified before the commencement of construction activity that may cause noise and vibrations.

The notice will include the following:

- An explanation of the proposed construction activity and its potential to produce noise and vibrations
- A statement of the levels of construction noise and vibration that are prohibited
- The location of the construction site where the construction activity will occur
- The date and time that the work will occur
- Duration of the work
- Contact information through which a person affected by noise and vibrations may contact GrandLinq
- Complaints protocol

Construction Noise Management Plan

Noise Impact Criteria

Noise impact assessment criteria are derived from the Corporation of the City of Waterloo By-Law No. 2010-073 and the City of Kitchener, Municipal Code Chapter 450, Noise. Reference is also made to MOE Publications NCP-101, 102, 103 and 206. The MOE does not stipulate receptor-base sound level limits for construction activity but rather places restrictions on the sound levels from common construction equipment as stated in its publication MOE NPC-115. Noise impact levels are developed from the specifics of the equipment to be used in the construction activities and the construction methodology. The MOE guidelines are written to restrict maximum allowable sound levels for equipment used in certain construction activities.

Noise Source

Current information on sound levels for each significant piece of equipment proposed for use in the Work will be listed. Source based guidelines for much of this equipment is stated in NPC-115 "Construction Equipment". The validity of this data will be confirmed through noise monitoring and adjusted where necessary for major items of equipment once site works have commenced. All work activities likely to generate significant noise in the execution of the work will be stated. Equipment to be used during each activity will be listed and an estimate made of its use during the activity.

Predicted Noise Levels

Noise levels for the main equipment items using the proposed construction methodology and located at the minimum distance to each of the nearest sensitive receptors will be calculated for each activity. Predicted noise level targets will be stated as those noise levels recorded at one meter from the most exposed building façade for the portion of the activity where the equipment is operating closest to the sensitive receptor.

Noise Mitigation

On this basis of predicted noise levels, when noise level targets are exceeded, general noise control measures (Table 5) will likely be required to maintain compliance with the construction noise criteria and conform to good practice.

Table 3: Noise Mitigation

Equipment/Process	General Noise Control Measures

Equipment/Process	General Noise Control Measures
All	Select equipment with noise levels at the lower end of the range
	Only use the required power and size of equipment
	Fit engine exhausts with mufflers
	Operate equipment in a quiet and efficient manner
	Do not leave equipment idling unnecessarily
	Regularly inspect and maintain equipment
	If practical use non-tonal reversing alarms
	Avoid slamming doors and tailgates
	Minimize speed and engine revs
	Turn off radios and audio equipment
	Minimize the use of horns
	Place bedding layer in dump-truck boxes
	Adjust the time of day and the duration of activities
	Use localized screening screening/enclosure where required

Equipment/Process	General Noise Control Measures
Tracked Equipment	Avoid tracked equipment where practicable
	Grease tracks regularly
Hydraulic Breakers	Use low-noise bracket on concrete breaker

Noise Monitoring

Noise monitoring will be conducted by trained noise monitoring staff under the direction of the Environmental Manager using dedicated sound level meter kits that are calibrated and certified. The calibrator will be verified by an accredited laboratory annually and the sound level meter and microphone biannually.

Monitoring will be conducted as follows:

- When an activity commences, to verify the sound levels assumed for each of the major items of equipment in order to assess the effective of noise control measures and the implementation of the control plan
- At regular intervals during the execution of the Work to check ongoing compliance with the construction noise criteria
- During critical phases of construction, such as during the use of heavy earth moving equipment, ballast tampers, piling rigs, concrete breakers, and other noisy activities in close proximity to sensitive receptors
- As required by a specific construction noise management plan
- When required, in response to construction noise related complaints

Where noise monitoring indicates that project noise criteria are being exceeded where this was not anticipated for the activity/location, then the noise management plan will be reviewed and a

plan will then be immediately prepared, since calculations or assessments assumed this was not initially required. It is at this point where consideration will be given to seeking an exemption to the noise by-laws.

Following each noise monitoring survey, the results will be reported and any issues discovered will be investigated.

Noise Assessment Locations

The CNVMP will identify sensitive receptors which will be identified as controlling points for construction noise monitoring. Residential properties closest to the alignment will generally be the most impacted by noise levels and therefore assessing compliance at these controlling points will ensure compliances at residences and commercial properties further away.

Specific construction methodology and construction activities using specialized equipment will require greater assessment of noise levels, additional noise monitoring, and stringent management and mitigation measures. Examples include:

- Concrete demolition for existing bridges and culverts
- Piling for new culvert construction and new bridge construction
- Erection of bridge steel superstructures
- Night work for tie-ins to municipal utilities
- Night work for street paving

Construction Vibration Management Plan

Vibration Impact Criteria

Vibration impact assessment criteria to be used are derived from the Regional Municipality of Waterloo "Construction Activity Vibrations Specifications". The allowable peak particle velocity (PPV) for continuous vibration activity such as vibratory pile driving or vibratory compaction is 12.0mm/sec. The allowable peak particle velocity (PPV) for impact vibration activity such as

diesel hammer pile driving or hoe ram activity is lower and dependent on a variety of criteria which must be assesses by the qualified acoustics/vibration specialist

Vibration impacts can be separated into two categories. The first category is levels at which the vibration may be felt to cause annoyance and concern; typically in the order of 0.35 to 0.5mm/sec. The second category comprises levels at which damage to buildings and infrastructure might occur; typically in the order of 3mm/sec for heritage listed buildings without modern foundations, 5 mm/sec for residential dwellings and 20mm/sec for commercial, industrial buildings.

Vibration limits will not be considered with respect to human comfort but solely for structural damage.

Vibration Sources

Construction activities such as vibratory compaction of subgrade, pile driving and concrete demolition have the potential to generate high vibration levels. In such cases a vibration impact study will be prepared by a Professional Engineer to assess vibration levels, their impact and their zone of influence.

Zone of Influence

The zone of influence will include infrastructure, structures and any buildings that have been designated under the Ontario Heritage Act that may be impacted by vibrations emanating from the construction activity where the peak particle velocity (PPV) measured at the point of reception exceeds a certain prescribed limit.

In determining the zone of influence the Engineer will consider the following:

- Soil conditions of the construction zone and adjacent land
- Weather conditions that will exist at the time of construction that may result in construction vibrations
- Whether the proposed construction will be above or below the water table

- The presence of heritage designated properties, sensitive structures or buildings and infrastructure
- The precise location of the source of vibration
- Unique site conditions

The Regional Municipality of Waterloo "Construction Activity Vibrations Specifications" prescribes a zone of influence of a minimum 30 meters from the activity or the greater of 30 meters or two times the depth of the activity below ground level.

Predicted Vibration Levels

With the zone of influence determined, vibration levels for the main equipment items using the proposed construction methodology and the minimum distance to each of the nearest sensitive receptors will be calculated for each activity. These indicative calculations will be generated from available information and guidelines. The validity of this data will be confirmed through vibration monitoring and adjusted where necessary for major items of equipment once site works have commenced. Predicted vibration levels will be stated as those levels recorded at one meter from the most exposed building façade for the portion of the activity where the equipment is operating closest to the sensitive receptor.

Predicted vibration levels for relative distances from the work site will be compared to the stated vibration criteria or allowable vibration levels to determine the potential for vibration induced structural damage. Where predicted vibration levels exceed the vibration criteria for damage to structures, then a pre-construction vibration monitoring and consultation program will be undertaken in order to refine the predicted vibration levels and to define the requirements for building condition surveys and public consultation in the vicinity of the works.

Building Condition Surveys

Where pre-construction monitoring indicates vibration levels from construction activity exceeds the vibration criteria, then building construction surveys of all potentially affected structures within the zone of influence will be undertaken prior to commencement of the works. The survey work will be undertaken by an engineer specialized in conducting building condition surveys. A report will be prepared for each building surveyed and will identify existing cracks in walls, floors and exterior cladding of the first two floors above grade and interior finishes of all floors below grade in sufficient detail to facilitate comparison of pre and post construction condition.

Sketches and photographs will document the extent and location of existing damage. The engineer will seek verification of the report by the building owner. Where it is not possible to gain access for a pre-construction condition survey statements of the efforts made to gain access will be provided.

Following completion of the works all building condition surveys will be repeated. Reports will be prepared including sketches and photographs of any new damage as verified by the building owner.

Vibration Mitigation

On this basis of predicted vibration levels, general vibration control measures will be identified as likely to be required to maintain compliance with the construction vibration criteria and conform to good practice.

Typical vibration mitigation measures are provided in Table 5 below.

Table 5: Vibration Mitigation Measures

Equipment/Process	General Vibration Control Measures
All	Select equipment with vibration levels at the lower end of the range
	Only use required power and size of equipment
	Operate equipment in a smooth and efficient manner
	Train operators in the correct use of equipment to minimize vibration
	Operate vibrating plant at the maximum practicable distance to a sensitive receptor
Vibratory Compactors	Reduce compactor displacement settings to reduce vibration power levels

Concrete Breaker	Only use where concrete cannot be broken up using an excavator and concrete saws

Vibration Monitoring

Vibration monitoring will be conducted to measure variances in the vibration levels before and during construction activities in compliance with the Construction Noise & Vibration Management Plan. Readings will be taken by trained vibration monitoring staff under the direction of the Environmental Manager and all results will be verified by a professional vibration engineer

Vibration monitoring will be conducted using dedicated accelerometer/geophones or vibration meters calibrated and certified annually. Vibration will be conducted during piling operations, concrete demolition, where called for under a vibration management plan or in response to a construction vibration related complaint.

Vibration Assessment Locations

The CNMP will identify controlling points for construction vibration monitoring of premises that are within a zone of influence and thus impacted by construction vibration levels. Designated heritage and historically significant structures subject to condition surveys will be also be monitored for construction vibration levels when works are conducted within 50 metres of these designated structures.

Specific construction methodology and construction activities using specialized equipment will require specific assessment of vibration levels, additional vibration monitoring, and stringent management and mitigation measures. Examples include:

- Concrete demolition for existing bridges and culverts
- Piling for new culvert construction and new bridge construction

Documentation

The following will comprise the documentation and reporting requirements of the Construction Noise & Vibration Management Plan:

- Construction Noise and Vibration Management Plan and all revisions
- All Construction Noise and Vibration Management Plan noise induction sheets and training records.
- Monitoring equipment kit details and calibration summary
- Copies of equipment calibration certificates
- Noise and vibration monitoring logs, field data and records
- Consultation and complaints registers
- Site survey sheets and associated aerial photographs
- Site survey summary sheets
- Building Condition Survey Reports

Reporting

Table 6 identifies reporting deliverables that will be provided, along with the timeframes stated.

Table 6: Reporting Timeframe

Information	**Timeframe**
Construction Noise and Vibration Management Plan	Before works commence
Localized Construction Noise/Vibration Management Plans	At least one week before specific works commence
Noise/vibration survey reports	Within one week of monitoring
Noise/vibration complaint initial report	Within twenty-four hours
Noise/vibration complaint closed	Within one week of closing complaint

Construction Noise & Vibration Plan Induction

To ensure noise criteria are achieved at those residential and commercial sensitive receptors in close proximity to the work, all construction personnel are responsible for good noise and vibration management and will be instructed as follows:

- When arriving at work, drive slowly on site and keep revs to a minimum. Keep stereos off and do not slam doors.
- Equipment and vehicles should not be left running when not in use.
- Refrain from shouting or swearing on site. Either walk over and talk to somebody or use a radio/phone.
- Be careful with tools and equipment. Place them down and do not drop them.
- Do not drag materials on the ground. Place them down when you arrive at the work area.
- When loading trucks, refrain from dropping material from a height.
- Noise enclosures should always have all doors/hatches closed when the equipment is in use.
- Stationary equipment such as pumps and generators should be located away from sensitive receivers.
- All equipment is to be properly maintained at all times.
- No work that could cause noise and/or vibration disturbance will be conducted outside the hours of 7:00 AM to 7:00 PM Monday to Saturday and no work at all will be conducted outside the hours of 7:00 PM to 7:00 AM.
- Intervene in cases where unnecessary noise is being generated. If the source cannot be stopped then report it to your immediate supervisor to the Environmental Manager
- Always maintain good relationships with the local community; motorists, pedestrians, residents and business owners alike. Do not enter into debate or argue with members of the public.

- Any queries from members of the public should be responded to politely and referred to the Environmental Manager Staff will assist the public to make contact with this person.
- No work that could cause noise and/or vibration disturbance is to be conducted until all staff involved in the task have read and signed the specific Construction Noise/Vibration Management Plan for that specific task and its specific location.

4.3 Project Schedule

4.3.1 General Requirements

GrandLinq has provided a detailed plan showing the sequence and logic for the execution of the Works from Phase 1 to Phase 3. The Critical Path Method (CPM) is adopted, using Oracle's Primavera P6 software. While P6 version 8.3 or later is the backbone for its planning, monitoring and controlling process, the intention is to utilize an integrated and tailored approach to the scheduling process. This “best tool for the job” approach involves the integration of P6 with:

- Tilos for Linear activities
- Synchro 4D for Structures
- Deltek’s Acumen for both schedule analysis and schedule risk qualification and quantification

4.3.4 Schedule Updates

GrandLinq will develop a schedule recovery strategy by creating a Schedule Recovery Task Force. This is established to oversee the proper assessment of schedule slippage and to develop and successfully implement all Schedule Recovery Plans that mitigate potential slippage and recover schedule loss. The Schedule Recovery Task Force is headed by the Construction Manager and includes the Scheduling Manager, and all responsible Discipline Field Superintendents, assisted by other resources such as QA/QC, traffic management, engineering, permitting and communications. The Schedule Recovery Task Force analyzes the root cause of the schedule slippage, develops the strategies for mitigation of any further schedule loss as well as plans to recover any schedule loss. The Task Force oversees implementation of all strategies until such time as the schedule loss has halted and any schedule loss is recovered. Approval of

the Recovery Plan is obtained from the Region before any actions aimed at mitigation or recovery of schedule slippages is implemented.

4.4 Construction Safety

4.4.1 Zero Harm Policy and Construction Safety

In respect of construction safety, workplace health and safety reps will be certified Joint Health and Safety members and EHS staff members will hold industry recognized certifications such as Construction Health and Safety Officer (CHSO), Gold Seal, or Certified Registered Safety Professional (CRSP). GrandLinq will promote continuous health and safety training to all project team members throughout the Project.

4.5 Construction Quality and Workmanship

4.5.1 Approach to Construction Quality

The Quality Management System (QMS) shown in Figure 1 below illustrates GrandLinq's commitment to quality at the highest levels of the organization. It emphasizes that quality starts during the bid phase of the Project and continues throughout Phase 1 and Phase 2 and into Phase 3. GrandLinq is committed to continual improvement; all GrandLinq team members, including staff, subcontractors and suppliers, will execute Project procedures and processes to attain Project Quality Objectives. It is the policy of GrandLinq to:

- Pursue high standards of Quality Management as an integral part of efficient implementation of the PA requirements and ensure that business decisions consider client and stakeholder requirements
- Implement a strong quality awareness and quality training program
- Review, develop and improve processes and procedures as work progresses to facilitate lessons learned and best practices
- Establish and maintain effective communication channels and tools with Project stakeholders

- Depend upon strong internal control and a full scope audit program
- Develop and review at least annually our objectives, critical success factors and performance indicators to continuously strive for excellence in business performance
- Review and, if applicable, revise the GrandLinq policies on an annual basis

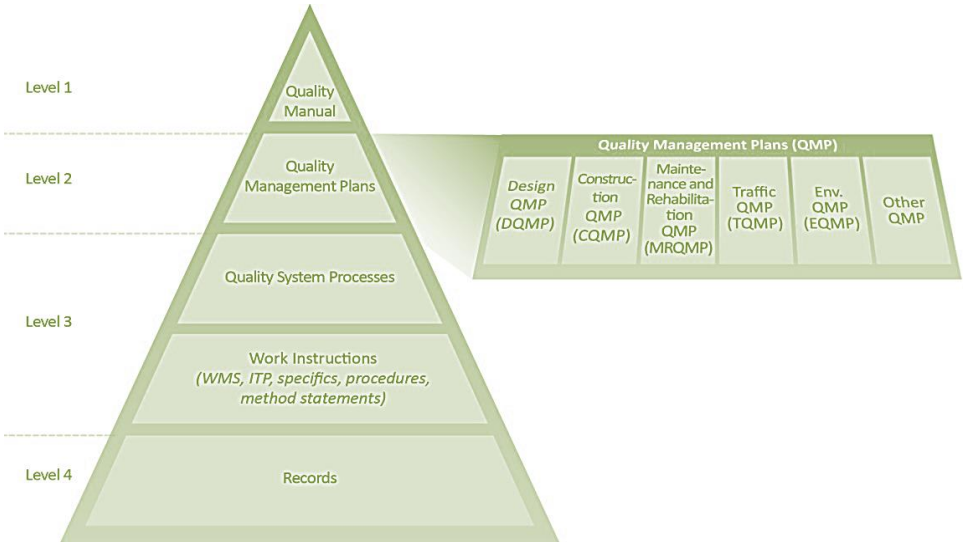


Figure 1: Quality Management Plans

5.1 Maintenance & Rehabilitation Organization & Key Personnel

5.1.1 Maintenance and Rehabilitation, Organization for Phase 3

The Maintenance Team will be led by the Manager of Maintenance, Dominique Hetuin, who will serve as the single point-of-accountability to GrandLinq's General Manager, Carl Williams, for all maintenance activities.

5.1.2 Key Maintenance & Rehabilitation Personnel

Table 4: Key Maintenance and Rehabilitation Personnel

Key Personnel Position	Key Personnel	Level of Involvement		Location		Deployment Date
		Full Time	Part Time	Region of Waterloo	Greater Toronto Area	
B5: Maintenance and Rehabilitation						
Manager of Maintenance	**Dominique Hetuin**	**X**		**X**		**March 2014**
Mr. Hetuin has 27 years of experience in operations and maintenance of urban rail systems, with seven years as Maintenance Director, seven years as O&M Manager and 13 years in the management of new urban rail projects, bringing expertise in the design, safety and maintenance of LRT systems to the Region. His unique blend of expertise in both the development and launch of new metro and LRT lines and the revenue phase has been called upon for many greenfield rail projects in France, as well as worldwide (Australia, Taiwan, US, Italy etc.) for projects and at the request of public transport authorities and other operators. Mr. Hetuin has been involved in the design of stations and OMSF, and has created technical specifications for procurement processes and supervised design construction launch and operation phases.						
Lead Vehicle Maintainer	**Anthea Antonio**	**X**		**X**		**March 2014**
Ms. Antonio is an articulate engineering manager who possesses excellent inter-personnel skills with a proven record managing maintenance of tram and railway infrastructure and in particular developing multi-skilled maintenance teams. Recently, Ms. Antonio served as the Chief Engineer for the London Tramlink where she was responsible for developing maintenance standards and construction specifications for an expanding network. She was also responsible for assurance of all infrastructure engineering activities and development of asset management system. Ms. Antonio also served as the Engineering Manager for the Nottingham Tram Consortium. Key project successes included developing a competence assurance system in conjunction with diploma studies; persuading LRT maintainer to alter wheel turning processes to reduce wear on infrastructure and on tyres; developing ties with SEMITAN, Nantes to provide additional support to vehicle maintainer; and directing development of track and wheel wear monitoring processes to improve replacement forecasts.						

Key Personnel Position	Key Personnel	Level of Involvement		Location		Deployment Date
		Full Time	Part Time	Region of Waterloo	Greater Toronto Area	
B5: Maintenance and Rehabilitation						
Lead Wayside Systems Maintainer	**TBD**	**X**		**X**		**March 2014**

The Lead Wayside Systems Maintenance Maintainer is accountable for Track, OHE, PSS and SIG maintenance production processes. As such, in coherence with Maintenance Division strategic targets, the position is in charge of trains' guidance, power supply, power delivery and signaling systems safety; covering the needs of Operations for these systems, including daily monitoring and short to mid-term anticipation); and maintenance organization and their performance survey implementation. The Wayside Systems Maintenance Lead must have experience in management either infrastructure maintenance or construction organization, ideally in a railway environment, demonstrated ability in human leadership, developing and driving initiatives related to operational performance improvement, technical matters (ideally regarding railway systems), quality management, and a strong background in legal and regulations issues related to public transport (ideally in a railway context). The minimum qualifications for this role are:

- Bachelor's Degree in Transportation Management, Engineering or a related field
- A minimum of 10 years of progressively responsible management experience in the maintenance of a Light Rail Vehicles
- Extensive experience in electro/mechanical maintenance or maintenance of LRV equipment.
- Experience in the management or supervision of rail transit vehicles maintenance activities.
- In-depth knowledge/understanding of rail vehicle operations/safety practices; includes vehicle rail system safety regulations.

Key Personnel Position	Key Personnel	Level of Involvement		Location		Deployment Date
		Full Time	Part Time	Region of Waterloo	Greater Toronto Area	
B5: Maintenance and Rehabilitation						
• Thorough understanding of all LRV maintenance operations, policies and procedures • Ability to communicate effectively, orally and in writing with tact and diplomacy; includes active listening and oral presentations • Basic computer skills, including word processing, spreadsheet and database applications and presentations • Effective interpersonal skills; including customer service and the ability to maintain effectiveness under stress and pressure situations. • Strong judgment and problem solving skills; includes the ability to identify problems, find workable solutions and make logical decisions sound judgment/common sense • Ability to plan ahead, manage time and prepare for a multiple projects, issues and situations; includes self-motivation, initiative and attention to detail • Ability to be flexible and adaptable; work various shifts, holidays, special events • Demonstrated ability to work effectively in a diverse workforce.						
Lead Facilities Maintainer	**TBD**	**X**		**X**		**March 2014**

Key Personnel Position	Key Personnel	Level of Involvement		Location		Deployment Date
		Full Time	Part Time	Region of Waterloo	Greater Toronto Area	
B5: Maintenance and Rehabilitation						
The Lead Facilities Maintainer is responsible for the stations equipment and buildings and premises maintenance production process. The candidate must have experience in management and subcontracting activities; demonstrated ability in human leadership, developing and driving initiatives relating to operational performance improvement, technical matters, quality management, and a strong background in legal and regulations issues related to public premises transport (ideally in a public transport context). The minimum qualifications for this role are: • Bachelor's Degree in Transportation Management, Engineering or a related field • A minimum of 10 years of progressively responsible management experience in the maintenance of a Light Rail System; • Detailed knowledge of Light Rail System maintenance and maximising resource • Detailed knowledge of all current legislation essential for compliance monitoring and Light Rail System Regulations • Working knowledge of safety management systems and processes • Ability to communicate effectively, orally and in writing with tact and diplomacy; includes active listening and oral presentations • Basic computer skills, including word processing, spreadsheet and database applications and presentations • Effective interpersonal skills; including customer service and the ability to maintain effectiveness						

Key Personnel Position	Key Personnel	Level of Involvement		Location		Deployment Date
		Full Time	Part Time	Region of Waterloo	Greater Toronto Area	
B5: Maintenance and Rehabilitation						
under stress and pressure situations. • Strong judgment and problem solving skills; includes the ability to identify problems, find workable solutions and make logical decisions sound judgment/common sense • Ability to plan ahead, manage time and prepare for a multiple projects, issues and situations; includes self-motivation, initiative and attention to detail • Ability to be flexible and adaptable; work various shifts, holidays, special events • Demonstrated ability to work effectively in a diverse workforce.						

5.3 System Service Availability Requirements

5.3.4 Availability of Other System and Facility Elements not Captured by the Availability Index

GrandLinq is committed to ensuring the highest level of performance of the System at all times. To this end, we are able to incorporate technology to capture data that is not directly required but that would measure many of the performance criteria effectively. One such system is an onboard diagnostic system that can measure the smoothness of the ride and evenness of track on set intervals. This not only helps System User's comfort, but also is able to "read" the condition of the track and switches, and identify those sections that could require maintenance work. The use of this technology can be more efficient than the visual inspections that are otherwise typically required.

6.1 Operations Organization and Key Personnel

6.1.2 Key Operations Personnel

The following Key Personnel are identified by the RFP. Please refer to the Organizational Chart for GrandLinq's organizational structure based on experience and best practices.

Each position will be full-time and the Managing Director and Operations managers will be assuming their roles during the construction phase in order to begin building their staff organization, and working closely with Design Build contract during this period to inspect project components as they are delivered. They will also be heavily involved in the Testing and Commission phase working closely with the LRV manufacturer, Bombardier, to ensure that the LRVs meet all operational requirements, and to coordinate with the Maintenance Manager how maintenance activities will be carried out.

Key Personnel Position	**Key Personnel**	**Level of Involvement**		**Location**		**Deployment Date**
		Full Time	**Part Time**	**Region of Waterloo**	**Greater Toronto Area**	
B6: Operations						
General Manager	**Carl Andrew Williams**	**X**		**X**		**March 2014**
Mr. Williams has 20 years of experience in public transport O&M – including 9 years as General Manager of light rail O&M subsidiaries, 5 years as Operations Manager, 3 years as shift manager, and 3 years as light rail project developer for leading UK public transport operators. Having worked in senior positions on three projects similar to the Waterloo LRT Stage 1, he has significant experience in providing O&M inputs at the design and construction phases of greenfield LRT projects, including those procured as DBFOM public-private partnerships, to ensure reliable and cost-effective operations. Since 2011, Mr. Williams has served as Project Director of Nottingham Tram Limited ("NTL"), the O&M subsidiary of Keolis on the Nottingham Express Transit Phase II DBFOM project ("NET"), with responsibilities for management of the early O&M Contractor inputs during the design and construction phases to ensure the successful launch of the two new light rail lines on time and per the required service level, and for developing and transforming the current organization of the operational Phase I LRT line						

Key Personnel Position	Key Personnel	Level of Involvement		Location		Deployment Date
		Full Time	Part Time	Region of Waterloo	Greater Toronto Area	
B6: Operations						
to a lean, customer centric organization able to address the challenges of the Phase II.						
Operations Manager	**Jean Luc Paruzetto**	**X**		**X**		**March 2014**

Jean-Luc has 23 years of experience in public transport operations at Keolis Lille, one of the largest Keolis urban transport networks (2,400 staff and $360 million annual revenue), with 18 years as Operations Manager of multiple public transit modes (subway, light rail, bus) and 4 years as Safety Manager. He is an accomplished people manager on public transit networks, leading teams of up to 400 operational staff. Jean-Luc knows how to motivate staff, ensuring all team members are engaged and working together effectively by involving them in the daily performance of the service and in the management of unforeseen incidents.

He also has significant experience as Operations Manager during the commissioning and launch phases, demonstrated through the highly successful projects of the Lille network: commissioning and launch of operations for the extension of the driverless subway Line 2 in 1995, where training and safety measures needs and support on commissioning were significant; launch of the new security OCC in 2002; and construction and transfer to a new OMSF of all bus operations in 2008. Jean-Luc implemented security policies and procedures that led to significantly reduced fraud levels in the urban area of Lille. Within Keolis, he is recognized as the specialist for all security issues on both subway and light rail networks